

Claims

- [c1] 1. A method for scanning a plurality of nucleic acid microarrays, comprising the steps of:
- (1) preparing a cell sample having nucleic acids;
 - (2) contacting the sample with an apparatus that comprises one or more containing members constructed and arranged to contain the plurality of nucleic acid microarrays, and a separating member constructed and arranged so that, when the separating member is disposed in a first position with respect to the containing members, at least two of the plurality of nucleic acid microarrays are fluidically separated from each other by the separating member, and when the separating member is disposed in a second position with respect to the containing members, the at least two microarrays are fluidically coupled with each other;
 - (3) applying excitation radiation to at least two of the plurality of nucleic acid microarrays; and
 - (4) detecting emission signals from the at least two nucleic acid microarrays.
- [c2] 2. A multi-array scanning system for scanning a plurality of microarrays disposed on a substrate, comprising:
- a scanner apparatus constructed and arranged to detect emission signals from at least two of the plurality of microarrays; and
 - a convertible processing apparatus including one or more containing members constructed and arranged to contain the substrate and a separating member constructed and arranged so that, when the separating member is disposed in a first position with respect to the containing members, the at least two microarrays are fluidically separated from each other by the separating member, and, when the separating member is disposed in a second position with respect to the containing members, the at least two microarrays are fluidically coupled with each other.
- [c3] 3. The system of claim 2, wherein:
- the scanner apparatus comprises
 - an excitation radiation source;
 - a focusing system constructed and arranged to focus radiation from the excitation radiation source onto a selected first portion of the substrate including the at least two microarrays;

a radiation direction system constructed and arranged to scan the focused excitation radiation across the first portion of the substrate;
a detector constructed and arranged to detect the emission signals from the first portion of the substrate in response to the focused excitation radiation; and
a data acquisition system constructed and arranged to record an amount of the emission signals detected as a function of positions on the first portion of the substrate from which the emission signal was emitted.

- [c4] 4. The system of claim 3 , wherein:
the focusing system includes an objective lens having a ratio of scanning field diameter to focused spot diameter of greater than about 2000, and a numerical aperture greater than about 0.2.
- [c5] 5. The system of claim 3 , wherein:
the radiation direction system includes a mirror selected from the group consisting of a galvanometric mirror, angularly oscillating mirror, or a rotating polyhedral mirror for reciprocally scanning the focused excitation radiation.
- [c6] 6. The system of claim 5 , wherein:
the focused excitation radiation is reciprocally scanned across a second portion of the substrate including a selected one of the at least two microarrays at a rate of at least 20 image lines per second.
- [c7] 7. The system of claim 3 , wherein:
the data acquisition system includes a computer having a processor and a memory, wherein the computer is constructed and arranged to receive image data representing the detected emission signals from the scanner apparatus and to store the image data in the memory.
- [c8] 8. The system of claim 7 , wherein:
the computer, when executing a scanner control, data acquisition, and data analysis application, further is constructed and arranged to control the focusing system and the radiation direction system so as to sequentially focus on and irradiate a first of the at least two microarrays and then sequentially focus on and irradiate one or more other of the at least two microarrays.

- [c9] 9. The system of claim 8 , wherein:
the convertible processing apparatus is coupled to a translation stage; and
the scanner apparatus further comprises a translation stage controller constructed and arranged to move the translation stage, under the direction of the computer, in coordination with the focusing system and radiation direction system.
- [c10] 10. The system of claim 9 , wherein:
the translation stage controller moves the translation stage in an X direction, a Y direction, or both so as to sequentially position each of the at least two microarrays for irradiation.
- [c11] 11. The system of claim 10 , wherein:
the X and Y directions are orthogonal to each other.
- [c12] 12. The system of claim 10 , wherein:
the translation stage controller moves the translation stage in a Z direction orthogonal to a plane of the X and Y directions so as to sequentially position each of the at least two microarrays for focusing.
- [c13] 13. The system of claim 2 , wherein:
the one or more containing members include a first segment and a second segment in contact with the first segment, wherein the substrate is disposed between the first and second segments.
- [c14] 14. The system of claim 13 , wherein:
the separating member is disposed between the first and second segments when the separating member is in the first position, and is disposed apart from the first and second segments when the separating member is in the second position.
- [c15] 15. The system of claim 13 , wherein:
the substrate is retained in place by the first and second segments.
- [c16] 16. The system of claim 2 , wherein:
the separating member includes one or more walls constructed and arranged to fluidically separate the at least two microarrays when the separating member is disposed in the first position.

[c17] 17. The system of claim 16 , wherein:
the separating member includes a grid plate having a plurality of grid elements determined by the one or more walls, wherein each of the at least two microarrays is fluidically separated from each of the other at least two microarrays by a grid element when the separating member is disposed in the first position, and wherein each of the at least two microarrays is fluidically coupled with the other at least two microarrays when the separating member is disposed in the second position.

[c18] 18. The system of claim 17 , wherein:
the plurality of grid elements is equal in number to the plurality of microarrays.

[c19] 19. The system of claim 2 , wherein:
the plurality of microarrays include synthesized probe arrays wherein the probes comprise oligonucleotides.

[c20] 20. The system of claim 2 , wherein:
the plurality of microarrays are disposed on a contiguous surface of the substrate.

[c21] 21. A method for scanning a plurality of microarrays, comprising the steps of:
(1) fluidically separating at least two of the plurality of microarrays from each other;
(2) contacting the at least two microarrays with one or more target solutions while the at least two microarrays are fluidically separated;
(3) retaining the fluidic separation of the at least two microarrays for a first period of time sufficient for hybridization reactions, if any, to occur between the target solutions and the at least two microarrays;
(4) fluidically coupling the at least two microarrays after the first period has elapsed;
(5) performing one or more parallel fluidic processes on the at least two microarrays based, at least in part, on the fluidic coupling; and
(6) detecting emission signals from the at least two microarrays.

[c22] 22. The method of claim 21 , wherein:
step (6) further comprises the steps of
(a) providing an excitation radiation source;

- (b) focusing radiation from the excitation radiation source onto the at least two microarrays;
- (c) scanning the focused excitation radiation across the at least two microarrays;
- (d) detecting emission signals from the at least two microarrays in response to the focused excitation radiation; and
- (e) recording amounts of the emission signals detected as a function of positions from which the emission signal was emitted.

[c23] 23. The method of claim 22 , wherein:
step (6) (c) includes the step of reciprocally scanning across a first of the at least two microarrays at a rate of at least 20 image lines per second.

[c24] 24. The method of claim 22 , wherein:
step (6) (e) includes the steps of receiving image data representing the detected emission signals and storing the image data in a computer memory.

[c25] 25. The method of claim 21 , wherein:
step (6) further comprises the steps of

- (a) providing an excitation radiation source;
- (b) focusing radiation from the excitation radiation source onto a first of the at least two microarrays;
- (c) scanning the focused excitation radiation across the first microarray;
- (d) detecting emission signals from the first microarray in response to the focused excitation radiation;
- (e) recording amounts of the emission signals detected as a function of positions on the first microarray from which the emission signal was emitted;
- (f) changing the relation of the substrate to the excitation radiation to enable focusing of radiation from the excitation radiation source onto a second of the at least two microarrays;
- (g) scanning the focused excitation radiation across the second microarray;
- (h) detecting the emission signals from the second microarray in response to the focused excitation radiation; and
- (i) recording an amount of the emission signals detected as a function of positions on the second microarray from which the emission signal was emitted.

- [c26] 26. The method of claim 21 , further comprising the step of:
(7) removing at least a portion of the one or more target solutions after the first period has elapsed and prior to performing step (4).
- [c27] 27. The method of claim 21 , wherein:
the one or more fluidic processes include one or more of the group consisting of removing at least a portion of the one or more target solutions, washing, staining, or preserving.
- [c28] 28. The method of claim 21 , wherein:
the microarrays include synthesized probe arrays.
- [c29] 29. The method of claim 21 , wherein:
step (1) includes disposing a grid plate having a plurality of grid elements on the substrate in a first position so that each of the at least two microarrays is aligned with a grid element.
- [c30] 30. The method of claim 29 , wherein:
step (4) includes moving the grid plate in the first position to a second position away from the plurality of microarrays.
- [c31] 31. A method for analyzing nucleic acids using a plurality of nucleic acid microarrays, comprising the steps of:
(1) preparing a cell sample having nucleic acids;
(2) contacting the sample with an apparatus that comprises
one or more containing members constructed and arranged to contain the plurality of nucleic acid microarrays, and
a separating member constructed and arranged so that, when the separating member is disposed in a first position with respect to the containing members, at least two of the plurality of nucleic acid microarrays are fluidically separated from each other by the separating member, and when the separating member is disposed in a second position with respect to the containing members, the at least two microarrays are fluidically coupled with each other;
(3) providing an excitation radiation source;
(4) focusing radiation from the excitation radiation source onto one or more of the

plurality of microarrays;

(5) scanning the focused excitation radiation across the one or more microarrays;

and

(6) detecting the emission signals from the one or more microarrays in response to the focused excitation radiation.

[c32] 32. The method of step 31 , further comprising the step of:

(7) recording an amount of the emission signals detected as a function of positions from which the emission signal was emitted.

[c33] 33. A method for analyzing nucleic acids using a plurality of nucleic acid microarrays, comprising the steps of:

(1) preparing a cell sample having nucleic acids;

(2) contacting the sample with an apparatus that comprises one or more containing members constructed and arranged to contain the plurality of nucleic acid microarrays;

(3) providing an excitation radiation source;

(4) focusing radiation from the excitation radiation source onto one or more of the plurality of microarrays;

(5) scanning the focused excitation radiation across the one or more microarrays; and

(6) detecting the emission signals from the one or more microarrays in response to the focused excitation radiation.

[c34] 34. The method of step 33 , wherein:

the apparatus further comprises a separating member constructed and arranged so that, when the separating member is disposed in a first position with respect to the containing members, at least two of the plurality of nucleic acid microarrays are fluidically separated from each other by the separating member, and when the separating member is disposed in a second position with respect to the containing members, the at least two microarrays are fluidically coupled with each other.

[c35] 35. A method for scanning a plurality of microarrays, comprising the steps of:

(1) contacting at least two microarrays of the plurality of microarrays with one or more target solutions;

- (2) performing one or more parallel fluidic processes on the at least two microarrays; and
- (3) detecting emission signals from the at least two microarrays.

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